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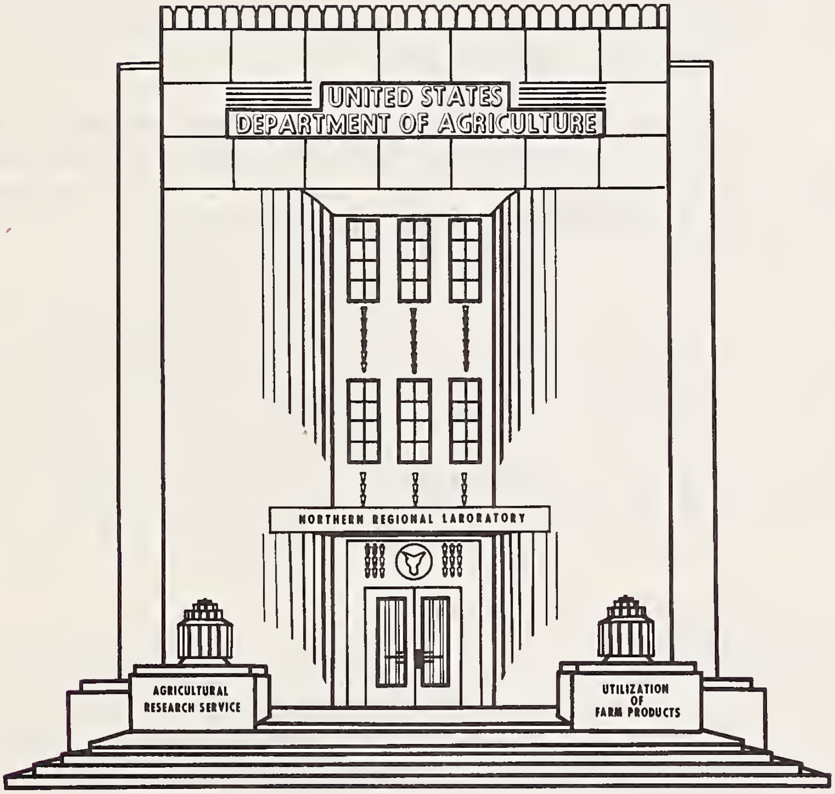
COMPOSITION OF COMMERCIAL GRADES OF CORN, OATS, AND GRAIN SORGHUMS


UNITED STATES
DEPARTMENT OF AGRICULTURE
NORTHERN REGIONAL LABORATORY
AGRICULTURAL RESEARCH SERVICE
UTILIZATION OF FARM PRODUCTS

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

The Northern Utilization Research and Development Division, Peoria, Ill., under the administration of the Agricultural Research Service of the U.S. Department of Agriculture, is one of four large research laboratories established by the Department under the authority of the Agricultural Adjustment Act of 1938. It was originally designated the Northern Regional Research Laboratory, but for a period it was also known as the Northern Utilization Research Branch.

The function of the several regional laboratories is to conduct chemical, engineering, and other scientific investigations on new uses of farm commodities and their derivatives. Commodities being investigated at the Northern Division include corn, wheat, grain sorghum, and other cereal grains; soybeans, flaxseed, and other oilseed crops; and new crops. Objectives of this research are to help farmers derive more income from their crops through expanded markets, to help industry convert agricultural raw materials into new and improved products, and to bring to consumers more and better farm-based commodities.

An important part of the investigations is the development of basic data on the composition and properties of the cereal grains under study. The major chemical constituents of corn, oats, and grain sorghum moving in commercial trade channels are given in this report.

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COMPOSITION OF COMMERCIAL GRADES OF CORN, OATS, AND GRAIN SORGHUMS[1]

By J. E. Hubbard,[2] F. R. Earle,[2] and J. J. Curtis[3]

COMPOSITION OF COMMERCIAL YELLOW CORN

Composition of a raw material is important to industry. Usually specifications for purchased material require some particular amount of one or more components, and frequently the price is based on the analysis of each lot. In contrast, corn-processing industries purchase their primary material on the basis of grade as defined by Official Grain Standards of the U.S. (8).[4] In a sense, grading is a type of prepurchase analysis since one of the grading factors is moisture content. High-moisture content lessens the value of grain per unit weight, and too much moisture adversely affects storage qualities.

Little information is available on the relationship between the composition of corn and the commercial grade. Anderson (1) reported that Canadian corn, grades 2CW to 5CW, varied little in protein, fiber, ash, and starch contents; but there were some differences in fat content among the grades he analyzed. Schaible (6) determined oil and protein contents of carlots of No. 2 yellow corn purchased by the Michigan Agricultural Experiment Station from 1932 to 1945. He reported considerable variation in protein content and some variation in oil content over the years. He concluded that there was a tendency toward lower protein percentages in the latter part of the period. Analyses of corn reported in a compilation by the National Academy of Sciences--National Research Council (5) include a breakdown by grades and by areas of production.

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[1] Composite samples of grains analyzed were obtained from the offices of the Grain Division, Agricultural Marketing Service, U.S. Department of Agriculture, at Omaha, Nebr.; Minneapolis, Minn.; Peoria, Ill.; Cedar Rapids, Iowa; Toledo, Ohio; St. Louis, Mo.; Kansas City, Mo.; and Fort Worth, Tex. We wish to thank the District Supervisors at each of these offices and H. P. English, East Central Area Supervisor at Chicago, Ill., for supplying the samples for analysis. Dr. W. F. Kwolek, Biometrical Services Division, ARS, assisted in the statistical treatment.

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[4] Underscored numbers in parentheses refer to Literature Cited, p. 6.

Among the grades within the same area of production, with the exception of ether extract, no differences in composition were apparent that could be associated with grade quality. Larger differences were evident in samples of the same grade but from different areas than in samples of different grades from the same area. Ether extract showed a small, but consistent, decrease with lower grade quality.

Materials and Methods

To determine variation in composition of commercial yellow corn from the Corn Belt among grades, locations, and years, composite samples of each of six grades of yellow corn were obtained from Peoria, Omaha, Minneapolis, Toledo, and Cedar Rapids for 5 crop years and for an additional 7 years from the first three locations. Samples were collected in May and June in an effort to get corn only from the preceding crop year. Samples to be composited were graded according to U.S. grain standards applicable at the time of collection. Then the composite sample for each grade was made by combining equal parts of weevil-free grain from each carlot received of that grade, excluding samples for which moisture was the limiting grading factor. After the composite samples were received at the Northern Regional Laboratory, they were stored at a temperature of 40° F. to prevent deterioration before analysis.

Samples were finely ground in a hammer mill with a 1/16-inch round-hole perforated screen just before analysis. Moisture was determined by heating at 130° C. for 2 hours and ash by heating at 550° C. for 4 hours. Nitrogen content was determined by the Kjeldahl-Wilfarth-Gunning method (2) except that a 4-percent solution of boric acid was used to receive the ammonia. Oil content was determined by a 20-hour petroleum-ether extraction in a Butt apparatus similar to the AOAC method for determination of oil content in soybean flour (2). Total sugar, determined by Scales' method (2), is reported as glucose. Starch was determined by the polarimetric method as described by Earle and Milner (3), except that uranyl acetate was used in place of stannic chloride.

Results and Discussion

Ash, protein, oil, sugar, and starch in composite samples collected from the five locations over the years 1941-1954, except 1942 and 1945, are presented in the Appendix, tables 1-5. Tables 6 through 8 summarize these data by grades, locations, and years. Composite samples of some grades were not available every year from all locations so that the averages do not afford an equal basis of comparison in all instances.

For each grade, the average, maximum, and minimum percentages of components are presented in the Appendix, table 6. For all components, the difference between maximum and minimum value for each component within each grade far exceeded the difference in average composition between grades. The average compositional values for ash, protein, and starch were so uniform for all grades as to indicate no correlation with grade. However, the higher quality grades were slightly, but consistently, higher in sugar content than the lower grades and appeared slightly higher in oil.

The average compositions of all grades of corn received at the five locations are presented in the Appendix, table 7. Ash and protein contents appear inversely related to starch content at the different locations. Samplings from Peoria and Cedar Rapids were lowest in ash and protein and highest in starch. Those from Toledo and Omaha were highest in ash and protein contents and low in starch. Corn from Minneapolis, which was lowest in starch, was almost as high in protein content as that from Toledo and Omaha. Differences in oil and sugar contents at the various locations were small. Whereas the regional data averages were not strictly comparable to those reported here, previous data (4) on composition of corn sampled from farmers' fields showed similar relationships. Samplings from the Nebraska area were higher in ash and protein contents and lower in starch content than those from the Illinois-Iowa area, and an inverse relationship was apparent between protein and nitrogen-free extract.

Average composition of the available grades by years is presented in the Appendix, table 8. Considerable variation is evident. However, any direct comparison of the figures should take into account that the number of samples contributing to the averages varied. The inverse relationship between starch and protein, and starch and ash is, however, still evident. Except for a slight lowering in protein content, no longterm trends in compositional changes are evident.

Samples were received for all but three grades from all five locations in 1941, 1944, 1946, and 1947. After calculating compositional values for the three missing samples, the analysis of variance was computed (Appendix, table 9). Ash, protein, sugar, and starch contents were significantly affected by location; oil content was not. Years, also, had a significant effect on all components but oil; differences in protein and sugar were at the 1-percent level of significance. The interaction location X years had a highly significant (1 percent) effect on oil, ash, protein, and starch, but not on sugar.

Grade had a highly significant effect on sugar and oil, but not on other constituents. Only protein was significantly affected by the grade X location interaction, and grade X years showed no significant effects.

To test the association between chemical components at different locations, correlation coefficients were determined for protein and starch, protein and oil, and starch and oil contents for the available grades from Peoria, Minneapolis, and Omaha. The variations in correlation coefficients associated with grade were not significant and are not given. The following coefficients, however, which are weighted averages over grade, are:

Location:	Correlation coefficient, r, for-- Protein X starch	 Protein X oil	 Starch X oil
Peoria - - - -	-0.59	+0.46	-0.41
Minneapolis- -	- .49	- .07	- .14
Omaha- - - - -	- .79	- .06	- .03

There were significant differences in the coefficients for each pair of variables associated with location. The protein X starch coefficient for corn from Omaha is significantly larger than those for corn from Peoria and Minneapolis. The protein X oil and starch X oil coefficients for corn from Omaha and Minneapolis were not significantly different from zero. The inverse relationship between protein and starch contents does not appear so high as might be expected, particularly at Minneapolis. A correlation as high as -0.88 for protein and nitrogen-free extract (NFE) was previously reported for commercial varieties of corn (4); also a correlation of -0.46 had been reported for fat and NFE.

Summary

Composite samples of grades 1 through 5 and sample grade of yellow corn were obtained from primary grain markets for all crop years from 1941 through 1954, except 1942 and 1945, and were analyzed for ash, protein, oil, sugar, and starch contents.

There were no significant differences between grades in ash, protein, and starch contents. The better grades were slightly but significantly higher in sugar content than the poorer grades and were also slightly, but significantly, higher in oil.

Location had a significant effect on all components except oil. Samples of yellow corn from Peoria and Cedar Rapids were low in ash and protein, high in starch. Those from Toledo, Omaha, and Minneapolis were high in protein and low in starch. Protein and starch were inversely related, as were also ash and starch.

Season or crop year also had a significant effect on all components but oil. Over the period studied, except for a slight lowering of protein content, no consistent trends in compositional variation were evident.

COMPOSITION OF COMMERCIAL WHITE CORN, OATS, AND GRAIN SORGHUMS

Trade in white corn, oats, and grain sorghums is based on Federal grades established by the Grain Division of the U.S. Agricultural Marketing Service. The grades for these grains are based on such factors as test weight, damaged and broken kernels, and foreign material without regard to chemical composition other than moisture content. Because the fundamental value of grain depends on its composition, samples of white corn, oats, and grain sorghums were obtained and analyzed to provide information comparable with that reported for yellow corn.

Materials and Methods

Samples of grain were collected from each location during a 4- to 6-week period when carlots of the current crop year were available. Whereas a more comprehensive series of grades was originally considered, the limited availability during the collection period of commercial samples representing all grades made collection of a series of grades for each grain class impractical. Each composite sample was made up by combining equal parts of weevil-free grain from all carlots of a given grade, based on a factor or factors other than moisture content, received at one location during each annual collection period. Composite samples of No. 1 and No. 2 white corn were obtained from St. Louis for several years and from Omaha for 1 year. No. 1 white oats were collected from Minneapolis and Cedar Rapids for 9 and 10 years, respectively, and No. 1 red oats from Fort Worth for 5 years. Yellow milo and white kafir grain sorghums were obtained from Kansas City and Fort Worth.

All samples were stored, prepared, and analyzed in the same manner as described for yellow corn, except that prior to determining the starch content of oats, the sample was washed with 0.05*N* sodium hydroxide and then dispersed in calcium chloride solution.

Results and Discussion

The limited number of grades, locations, and years makes any statistical analysis tenuous and makes unqualified statements about any relationship of grade to composition difficult. As with the samples of yellow corn analyzed, the season or crop year has a considerable influence on most components.

White corn is very similar to yellow corn in ash, protein, oil, sugar, and starch contents (Appendix, table 10). White corn was, however, slightly lower in oil content than the same grade of yellow corn collected at similar locations for the same years. This difference might have been because of the particular varieties grown in the areas or to the limited sampling rather than related to color. It was reported (4, 7) that in samples of corn collected all over the United States, white corn had a higher oil content than yellow corn. However, in a later compilation, the Committee on Feed Composition (5), in summarizing analyses of over 60 samples of white corn and 500 of yellow corn, cite percentages of ether extract of 4.2 for white corn and 4.4 for yellow. White corn at both St. Louis and Omaha was slightly higher in starch content than comparable yellow corn. White corn from Omaha averaged slightly higher in protein content and lower in starch content than that collected at St. Louis. This difference agrees with data on yellow corn (Appendix, table 7). Omaha corn had a higher protein content and lower starch content than corn received at Peoria and Cedar Rapids.

Analyses of oats are presented in the Appendix, table 11. White oats from Cedar Rapids had essentially the same composition as white oats from Minneapolis. Red oats from Fort Worth were higher in oil and ash contents and lower in protein, sugar, and starch contents than white oats from Cedar Rapids and Minneapolis. At each location, there was variability from year to year in all constituents determined. The high oil content of red oats can doubtless be attributed to varietal effect. Unpublished data from the Northern Utilization Research and Development Division on 20 varieties of oats grown in 1943 in Kansas, Iowa, and Indiana show that the red varieties Fultex, Fulton, and Kanota are very high in oil content compared with white varieties. Red oats grown in the Fort Worth area are derived from about the same oat strains as these varieties. In comparison with corn, these studies show that whole oats were higher in ash, protein and oil, lower in sugar, and much lower in starch.

Composition data for yellow milo are given in the Appendix, table 12, and for white kafir, in table 13. Grain sorghums are similar to corn in composition. However, they tend to be lower in oil content and higher in protein content than corn. The data on four grades of yellow milo collected from 1947 to 1949 at Kansas City show that protein increased and starch decreased with lower grade quality. This decrease could be associated with lower test weight or increased cracked grain and foreign materials, or both. In contrast to yellow corn, which showed a decrease in sugar with lower grade quality, these lower grade yellow milos had higher sugar contents than the high-grade ones. The data for 1953-55 were less consistent and even showed a slight decrease in protein for the lower grades, but this did not greatly affect the averages. The inverse relationship between protein and starch, however, was evident.

Data on yellow milo from Fort Worth and on white kafir were more variable; averages showed little correlation of composition with grade. The small number of samples sharply limited any unqualified conclusions.

Summary

Commercial samples of white corn, white oats, red oats, yellow milo, and white kafir were obtained from primary markets and analyzed for ash, protein, oil, sugar, and starch contents.

White corn was similar to yellow corn in composition except for pigments. Differences noted in the composition of the two types of corn may be related to varietal and location differences and not to color.

Oats were higher in protein, ash, and oil contents and lower in sugar and starch contents than corn. No. 1 red oats from Fort Worth had a very high oil content; this was probably associated with varieties.

Grain sorghums differed little in ash, protein, oil, sugar, and starch contents among grades, classes, and market locations although variations in composition from sample to sample were sometimes considerable. Grain sorghums were higher in protein content and lower in oil content than corn. They are, however, so similar to corn in composition that they can be used for feeding and for many industrial uses as a replacement for corn.

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APPENDIX

TABLE 1.--Ash content of commercial grades of yellow corn from 5 locations, 1941, 1943-44, 1946-54

[Moisture-free basis]

Location and grade1/	Percentage ash in yellow corn, by years												Average
	1941	1943	1944	1946	1947	1948	1949	1950	1951	1952	1953	1954	
Peoria:													
1-----	1.38	1.26	1.36	1.23	1.41	1.39	1.18	1.28	1.33	1.33	1.37	1.40	1.33
2-----	1.34	1.30	1.26	1.31	1.36	1.32	1.31	1.24	1.32	1.28	1.41	1.38	1.32
3-----	1.28	1.28	1.30	1.39	1.39	1.40	1.27	1.18	1.32	1.22	1.48	1.46	1.33
4-----	1.29	1.30	1.33	1.36	1.36	1.39	1.34	1.26	1.34	1.25	1.25	1.48	1.33
5-----	1.28	1.39	1.27	1.27	1.35	1.40	---	---	1.35	1.26	---	1.54	1.35
S.G.--	1.29	1.35	1.27	1.37	1.39	1.44	---	1.29	1.34	1.30	1.32	1.58	1.36
Average	1.31	1.31	1.30	1.32	1.38	1.39	1.28	1.25	1.33	1.27	1.37	1.47	1.33
Omaha:													
1-----	1.50	1.40	1.52	1.45	1.41	1.43	1.43	1.38	1.33	1.43	1.51	1.36	1.43
2-----	1.49	1.36	1.56	1.49	1.45	1.41	1.48	1.38	1.45	1.50	1.44	1.33	1.44
3-----	1.51	1.42	1.48	1.47	1.49	1.39	1.38	1.50	1.36	1.34	1.47	1.38	1.43
4-----	1.50	1.42	1.50	1.48	1.45	1.36	1.38	1.44	1.33	---	---	1.43	1.43
5-----	---	1.42	1.54	1.42	1.52	1.28	1.43	1.49	1.47	---	---	1.41	1.44
S.G.--	1.51	1.61	1.67	1.34	1.47	1.32	1.45	1.41	1.53	1.50	---	1.41	1.47
Average	1.50	1.44	1.54	1.44	1.46	1.36	1.42	1.43	1.41	1.44	1.47	1.39	1.44
Minneapolis:													
1-----	1.33	---	1.50	1.38	1.46	1.38	1.31	1.21	1.35	1.33	1.31	1.39	1.36
2-----	1.36	---	1.34	1.48	1.48	1.29	1.31	1.28	1.31	1.35	1.29	1.43	1.36
3-----	1.33	---	1.43	1.34	1.63	1.33	1.23	1.28	1.28	1.57	1.52	1.42	1.40
4-----	1.32	---	1.41	1.31	1.48	1.33	1.36	1.24	1.32	1.39	1.38	1.46	1.36
5-----	1.36	---	1.39	1.42	1.84	1.31	1.35	1.14	1.35	1.30	1.28	1.43	1.38
S.G.--	1.35	1.53	1.39	1.43	1.61	1.33	1.37	1.20	1.28	1.33	1.44	1.45	1.39
Average	1.34	---	1.41	1.39	1.58	1.33	1.32	1.22	1.32	1.38	1.37	1.43	1.37
Cedar Rapids:													
1-----	1.32	1.33	1.29	1.29	1.34	---	---	---	---	---	---	---	1.31
2-----	1.29	1.30	1.43	1.40	1.38	---	---	---	---	---	---	---	1.36
3-----	1.29	1.31	1.44	1.38	1.44	---	---	---	---	---	---	---	1.37
4-----	1.28	1.33	1.44	1.31	1.44	---	---	---	---	---	---	---	1.36
5-----	1.35	1.34	1.42	1.36	1.46	---	---	---	---	---	---	---	1.39
S.G.--	1.33	1.34	1.39	1.34	1.44	---	---	---	---	---	---	---	1.37
Average	1.31	1.32	1.40	1.35	1.42	---	---	---	---	---	---	---	1.36
Toledo:													
1-----	1.33	---	1.37	1.30	1.60	---	---	---	---	---	---	---	1.40
2-----	1.31	---	1.30	1.33	1.64	---	---	---	---	---	---	---	1.40
3-----	1.42	---	1.36	1.24	1.66	---	---	---	---	---	---	---	1.42
4-----	1.31	---	1.51	1.28	1.71	---	---	---	---	---	---	---	1.45
5-----	1.46	---	---	1.40	1.55	---	---	---	---	---	---	---	1.47
S.G.--	1.40	---	---	1.40	1.47	---	---	---	---	---	---	---	1.42
Average	1.37	---	1.38	1.32	1.60	---	---	---	---	---	---	---	1.42

1/ S.G., sample grade.

TABLE 2.--Protein content of commercial grades of yellow corn from 5 locations, 1941, 1943-44, 1946-54

[Moisture-free basis]

Location and grade[1]	Percentage protein in yellow corn, by years												Average
	1941	1943	1944	1946	1947	1948	1949	1950	1951	1952	1953	1954	
Peoria:													
1-----	10.4	9.4	9.8	9.2	10.5	9.4	9.3	9.3	8.9	9.6	10.1	9.9	9.6
2-----	10.2	9.5	9.5	9.6	10.2	9.2	9.3	9.2	8.9	9.1	10.1	10.4	9.6
3-----	10.3	9.6	10.3	9.8	10.1	9.5	9.3	9.4	9.1	9.2	9.8	10.4	9.7
4-----	10.1	9.4	9.5	9.8	10.2	9.6	9.4	10.0	8.9	9.3	10.2	10.6	9.8
5-----	10.4	9.4	10.0	10.2	10.5	9.9	---	---	9.0	9.9	---	9.9	9.9
S.G.--	10.2	9.6	9.8	10.0	10.2	9.9	---	10.1	8.9	9.4	9.5	10.3	9.8
Average	10.3	9.5	9.8	9.8	10.3	9.6	9.3	9.6	8.9	9.4	9.9	10.3	9.7
Omaha:													
1-----	11.6	9.8	10.5	9.8	10.4	9.8	9.9	9.9	9.3	9.9	9.8	9.4	10.0
2-----	11.6	9.8	10.7	10.0	10.6	10.2	9.9	10.0	9.6	9.9	9.9	9.4	10.1
3-----	11.6	10.6	10.2	10.1	10.5	10.4	9.6	10.1	9.6	10.1	10.3	9.5	10.2
4-----	11.8	10.7	10.7	10.4	10.6	9.9	10.3	10.1	9.4	---	---	9.5	10.3
5-----	---	9.9	10.0	10.3	10.9	9.9	10.5	10.2	9.9	---	---	9.2	10.1
S.G.--	11.8	9.9	10.2	10.7	10.4	10.1	9.9	10.3	10.0	10.3	---	9.4	10.3
Average	11.7	10.1	10.4	10.2	10.6	10.0	10.0	10.1	9.6	10.1	10.0	9.4	10.2
Minneapolis:													
1-----	11.2	---	9.7	10.1	10.8	9.9	10.2	10.3	10.3	10.2	8.9	9.9	10.1
2-----	10.9	---	9.8	10.1	10.8	10.1	10.1	9.9	10.3	10.0	9.4	9.6	10.1
3-----	11.2	---	9.6	9.9	10.7	9.9	10.2	10.2	9.9	10.1	10.1	9.6	10.1
4-----	10.9	---	10.1	9.9	10.6	9.8	10.1	9.9	9.9	9.9	10.2	9.3	10.1
5-----	11.3	---	9.8	10.1	10.6	10.1	10.3	10.3	10.4	10.1	10.1	9.7	10.3
S.G.--	11.3	10.1	10.2	10.1	11.2	9.9	10.3	10.1	9.8	9.8	10.1	9.4	10.2
Average	11.1	10.1	9.9	10.0	10.8	9.9	10.2	10.1	10.1	10.0	9.8	9.6	10.1
Cedar Rapids:													
1-----	10.5	9.8	10.0	9.8	10.5	---	---	---	---	---	---	---	10.1
2-----	10.5	9.6	9.8	9.8	10.2	---	---	---	---	---	---	---	10.0
3-----	10.5	9.8	10.0	10.1	10.5	---	---	---	---	---	---	---	10.2
4-----	10.4	9.8	9.6	9.9	10.8	---	---	---	---	---	---	---	10.1
5-----	10.4	9.5	8.9	10.3	9.7	---	---	---	---	---	---	---	9.8
S.G.--	10.6	9.5	9.4	10.4	10.1	---	---	---	---	---	---	---	10.0
Average	10.5	9.7	9.6	10.0	10.3	---	---	---	---	---	---	---	10.0
Toledo:													
1-----	10.8	---	9.9	9.8	9.9	---	---	---	---	---	---	---	10.1
2-----	10.8	---	9.7	9.8	9.9	---	---	---	---	---	---	---	10.0
3-----	10.8	---	9.8	9.5	9.7	---	---	---	---	---	---	---	10.0
4-----	11.1	---	9.6	9.7	10.2	---	---	---	---	---	---	---	10.1
5-----	11.2	---	---	9.8	9.9	---	---	---	---	---	---	---	10.3
S.G.--	11.0	---	---	10.5	10.6	---	---	---	---	---	---	---	10.7
Average	10.9	---	9.8	9.8	10.0	---	---	---	---	---	---	---	10.2

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[1] S.G., sample grade.

TABLE 3.--Oil content of commercial grades of yellow corn from 5 locations, 1941, 1943-44, 1946-54

[Moisture-free basis]

Location and grade 1/	Percentage oil in yellow corn, by years												Average
	1941	1943	1944	1946	1947	1948	1949	1950	1951	1952	1953	1954	
Peoria:													
1-----	4.7	4.4	4.2	4.4	4.4	4.8	4.4	4.4	4.4	4.6	4.8	4.3	4.5
2-----	4.7	4.4	4.2	4.4	4.3	4.6	4.2	4.1	4.3	4.3	4.5	4.7	4.4
3-----	4.7	4.4	4.2	4.5	4.2	4.6	4.0	4.1	4.0	4.2	4.2	4.6	4.3
4-----	4.6	4.4	4.2	4.4	4.1	4.7	4.5	4.1	4.2	3.9	4.5	4.7	4.4
5-----	4.4	4.3	4.3	4.5	4.3	4.8	---	---	3.8	4.1	---	4.6	4.3
S.G.--	4.6	4.3	4.2	4.2	4.3	4.8	---	4.0	4.0	4.0	4.3	4.3	4.3
Average	4.6	4.4	4.2	4.4	4.3	4.7	4.3	4.1	4.1	4.2	4.5	4.5	4.4
Omaha:													
1-----	4.3	4.2	4.3	4.5	4.4	4.6	4.4	4.0	4.2	4.5	4.6	4.6	4.4
2-----	4.3	4.5	4.5	4.7	4.4	4.3	4.3	3.9	4.1	4.4	4.4	4.7	4.4
3-----	4.4	4.2	4.2	4.5	4.3	4.2	4.4	4.0	4.2	4.5	4.1	4.6	4.3
4-----	4.4	4.4	4.4	4.4	4.3	4.4	4.1	3.9	4.0	---	---	4.5	4.3
5-----	---	4.2	4.3	4.2	4.2	4.2	4.2	3.9	3.7	---	---	4.6	4.2
S.G.--	4.2	4.0	4.2	4.3	3.9	4.5	3.6	3.4	3.5	4.9	---	4.5	4.1
Average	4.3	4.3	4.3	4.4	4.2	4.4	4.2	3.8	4.0	4.6	4.4	4.6	4.3
Minneapolis:													
1-----	4.6	---	4.6	4.7	4.6	4.9	4.3	3.9	3.9	4.3	4.6	4.7	4.5
2-----	4.5	---	4.4	4.4	4.7	4.6	4.4	4.0	3.9	4.5	4.3	4.8	4.4
3-----	4.6	---	4.5	4.4	4.4	4.8	4.2	3.9	3.8	4.4	4.6	4.8	4.4
4-----	4.5	---	4.5	4.5	4.5	4.7	4.4	3.8	3.9	4.5	4.3	4.6	4.4
5-----	4.3	---	4.4	4.4	4.2	4.9	4.2	3.7	4.0	4.3	4.4	4.6	4.3
S.G.--	4.6	4.3	4.3	4.1	4.3	4.7	4.1	3.6	3.4	4.5	4.7	4.9	4.3
Average	4.5	---	4.5	4.4	4.4	4.8	4.3	3.8	3.8	4.4	4.5	4.7	4.4
Cedar Rapids:													
1-----	4.4	4.2	4.3	4.4	4.6	---	---	---	---	---	---	---	4.4
2-----	4.3	4.1	4.5	4.3	4.2	---	---	---	---	---	---	---	4.3
3-----	4.3	4.4	4.6	4.4	4.3	---	---	---	---	---	---	---	4.4
4-----	4.3	4.3	4.7	4.3	4.5	---	---	---	---	---	---	---	4.4
5-----	4.3	4.2	4.4	4.4	4.3	---	---	---	---	---	---	---	4.3
S.G.--	4.4	4.2	4.4	4.4	4.4	---	---	---	---	---	---	---	4.4
Average	4.3	4.2	4.5	4.4	4.4	---	---	---	---	---	---	---	4.4
Toledo:													
1-----	4.6	---	4.5	4.4	4.0	---	---	---	---	---	---	---	4.4
2-----	4.5	---	4.4	4.3	4.0	---	---	---	---	---	---	---	4.3
3-----	4.4	---	4.3	4.4	3.9	---	---	---	---	---	---	---	4.2
4-----	4.7	---	4.3	4.4	4.2	---	---	---	---	---	---	---	4.4
5-----	3.8	---	---	4.1	4.1	---	---	---	---	---	---	---	4.0
S.G.--	4.4	---	---	4.2	4.4	---	---	---	---	---	---	---	4.3
Average	4.4	---	4.4	4.3	4.1	---	---	---	---	---	---	---	4.3

1/ S.G., sample grade.

TABLE 4.--Sugar content of commercial grades of yellow corn from 5 locations, 1941, 1943-44, 1946-53

[Moisture-free basis]

Location and grade[1]	Percentage sugars in yellow corn, by years											Average
	1941	1943	1944	1946	1947	1948	1949	1950	1951	1952	1953	
Peoria:												
1-----	1.8	1.9	1.7	2.0	2.1	2.3	2.0	1.8	1.9	2.4	2.2	2.0
2-----	1.7	2.0	1.8	1.8	2.1	1.9	2.0	1.8	1.8	2.3	2.1	1.9
3-----	1.8	1.9	1.7	1.8	2.1	2.0	2.0	1.7	1.7	2.0	1.7	1.9
4-----	1.8	1.8	1.6	1.7	1.8	1.9	2.0	1.7	1.7	1.9	1.8	1.8
5-----	1.6	1.9	1.6	1.6	1.8	1.9	---	---	1.5	1.8	---	1.7
S.G.--	1.6	1.7	1.5	1.2	1.6	1.5	---	1.4	1.4	1.6	1.7	1.5
Average	1.7	1.9	1.6	1.7	1.9	1.9	2.0	1.7	1.7	2.0	1.9	1.8
Omaha:												
1-----	1.8	1.9	2.0	2.1	2.3	2.1	2.2	2.0	2.0	2.6	2.3	2.1
2-----	1.9	1.9	1.9	1.8	2.2	2.0	2.0	1.7	1.8	2.4	2.0	2.0
3-----	1.8	1.8	1.7	1.8	2.0	2.0	2.2	1.7	1.8	1.9	1.7	1.9
4-----	1.4	1.8	1.8	1.7	2.0	2.3	2.2	1.7	1.7	---	---	1.8
5-----	---	1.7	1.6	1.6	1.8	2.0	2.0	1.5	1.6	---	---	1.7
S.G.--	1.5	1.4	1.3	1.3	1.6	1.8	1.8	1.4	1.4	2.0	---	1.6
Average	1.7	1.8	1.7	1.7	2.0	2.0	2.0	1.7	1.7	2.2	2.0	1.9
Minneapolis:												
1-----	1.5	---	1.8	1.8	2.1	2.1	1.9	2.0	2.0	2.2	2.2	2.0
2-----	1.6	---	1.5	1.7	2.1	2.0	1.8	1.7	1.9	2.1	2.0	1.8
3-----	1.8	---	1.6	1.5	2.0	2.0	2.0	1.7	1.8	2.1	2.0	1.8
4-----	1.6	---	1.6	1.5	2.0	2.0	1.9	1.5	1.7	2.0	1.7	1.7
5-----	1.4	---	1.5	1.5	1.8	1.9	1.6	1.5	1.7	2.0	1.6	1.7
S.G.--	1.3	1.5	1.2	1.3	1.8	1.7	1.7	1.5	1.3	1.9	1.6	1.5
Average	1.5	---	1.5	1.6	2.0	2.0	1.8	1.7	1.7	2.0	1.8	1.8
Cedar Rapids:												
1-----	2.0	2.0	1.8	1.8	2.3	---	---	---	---	---	---	2.0
2-----	1.8	2.0	1.7	1.7	2.1	---	---	---	---	---	---	1.9
3-----	1.5	1.8	1.7	1.7	2.0	---	---	---	---	---	---	1.7
4-----	1.6	1.9	1.5	1.7	2.0	---	---	---	---	---	---	1.7
5-----	1.6	1.6	1.4	1.6	1.8	---	---	---	---	---	---	1.6
S.G.--	1.4	1.6	1.3	1.4	1.7	---	---	---	---	---	---	1.5
Average	1.6	1.8	1.6	1.6	2.0	---	---	---	---	---	---	1.7
Toledo:												
1-----	1.9	---	1.9	1.6	2.0	---	---	---	---	---	---	1.9
2-----	1.8	---	1.8	1.7	1.8	---	---	---	---	---	---	1.8
3-----	1.7	---	1.5	1.9	1.9	---	---	---	---	---	---	1.7
4-----	1.8	---	1.4	1.6	2.1	---	---	---	---	---	---	1.7
5-----	1.4	---	---	1.6	1.6	---	---	---	---	---	---	1.5
S.G.--	1.4	---	---	1.4	1.4	---	---	---	---	---	---	1.4
Average	1.7	---	1.6	1.6	1.8	---	---	---	---	---	---	1.7

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[1] S.G., sample grade.

TABLE 5.--Starch content of commercial grades of yellow corn from 5 locations, 1941, 1943-44, 1946-54

[Moisture-free basis]

Location and grade[1]	Percentage starch in yellow corn, by years												Average
	1941	1943	1944	1946	1947	1948	1949	1950	1951	1952	1953	1954	
Peoria:													
1-----	72.8	73.1	72.5	72.9	71.0	71.6	72.1	73.1	73.9	72.2	71.3	72.8	72.4
2-----	72.5	73.3	73.5	72.7	71.4	72.5	72.5	73.5	74.2	72.5	68.2	72.2	72.4
3-----	72.3	72.5	73.0	72.3	71.4	72.4	73.0	73.1	73.9	74.2	70.6	72.1	72.6
4-----	72.6	72.9	72.8	71.9	72.0	72.8	72.3	73.2	74.3	72.9	70.3	71.6	72.5
5-----	74.4	73.0	72.5	72.4	71.7	71.4	---	---	74.9	72.4	---	72.2	72.8
S.G.--	73.2	73.5	72.5	72.6	72.0	72.5	---	73.2	74.5	72.9	71.7	72.0	72.8
Average	73.0	73.0	72.8	72.5	71.6	72.2	72.5	73.2	74.3	72.8	70.4	72.2	72.6
Omaha:													
1-----	70.3	72.3	72.1	71.9	71.2	71.7	71.4	72.5	73.0	72.2	71.8	72.9	71.9
2-----	69.5	72.3	71.8	71.6	71.0	71.6	71.5	72.5	72.5	72.6	72.1	73.1	71.8
3-----	70.7	71.8	72.0	71.8	72.1	72.2	72.3	71.5	72.2	72.4	72.4	72.9	72.0
4-----	71.4	71.7	71.9	71.4	70.9	72.5	71.4	72.0	72.5	---	---	72.6	71.8
5-----	---	72.7	72.0	72.4	70.4	72.0	71.3	71.9	71.8	---	---	72.6	71.9
S.G.--	71.1	72.6	71.6	72.0	71.0	71.7	72.2	71.9	72.0	70.9	---	71.9	71.7
Average	70.6	72.2	71.9	71.8	71.1	72.0	71.7	72.0	72.3	72.0	72.1	72.7	71.9
Minneapolis:													
1-----	71.4	---	72.1	71.3	71.7	71.6	71.7	71.8	71.5	71.5	71.5	72.3	71.7
2-----	72.3	---	73.1	71.3	71.2	71.7	70.7	72.2	72.2	71.6	71.9	72.4	71.9
3-----	72.0	---	72.4	72.1	70.9	71.5	71.5	71.9	72.6	71.8	71.9	72.6	71.9
4-----	71.8	---	72.0	71.7	71.7	72.1	72.1	71.9	72.2	72.1	72.0	72.1	72.0
5-----	70.9	---	72.8	72.0	71.2	71.4	71.6	71.8	71.9	72.8	70.8	72.0	71.7
S.G.--	70.7	72.3	72.3	72.5	70.0	72.4	72.2	71.9	73.2	72.2	70.2	72.1	71.8
Average	71.5	---	72.4	71.8	71.1	71.8	71.6	71.9	72.3	72.0	71.4	72.3	71.8
Cedar Rapids:													
1-----	71.3	72.3	72.7	72.2	71.8	---	---	---	---	---	---	---	72.1
2-----	72.5	73.6	72.1	72.0	71.9	---	---	---	---	---	---	---	72.4
3-----	72.4	73.5	72.4	71.8	71.4	---	---	---	---	---	---	---	72.3
4-----	73.2	73.1	72.8	72.3	71.5	---	---	---	---	---	---	---	72.6
5-----	72.1	72.7	72.4	71.9	71.8	---	---	---	---	---	---	---	72.2
S.G.--	74.4	74.6	73.6	71.6	72.3	---	---	---	---	---	---	---	73.3
Average	72.6	73.3	72.7	72.0	71.8	---	---	---	---	---	---	---	72.5
Toledo:													
1-----	72.5	---	72.9	72.0	71.6	---	---	---	---	---	---	---	72.2
2-----	71.8	---	72.6	72.7	72.9	---	---	---	---	---	---	---	72.5
3-----	72.3	---	72.3	72.4	72.4	---	---	---	---	---	---	---	72.4
4-----	71.3	---	73.5	72.1	71.5	---	---	---	---	---	---	---	72.1
5-----	71.6	---	---	72.0	73.1	---	---	---	---	---	---	---	72.2
S.G.--	71.3	---	---	71.5	72.0	---	---	---	---	---	---	---	71.6
Average	71.8	---	72.8	72.1	72.2	---	---	---	---	---	---	---	72.2

[1] S.G., sample grade.

TABLE 6.--Composition of commercial yellow corn, by grades

[Moisture-free basis]

Grade	Analyses	Composition of yellow corn				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
	Number	%	%	%	%	%
No. 1:						
Average ---	44	1.37	10.0	4.4	2.0	72.1
Maximum ---		1.60	11.6	4.9	2.6	73.9
Minimum ---		1.21	8.9	3.9	1.5	70.3
No. 2:						
Average ---	44	1.37	10.0	4.4	1.9	72.1
Maximum ---		1.64	11.6	4.8	2.4	74.2
Minimum ---		1.24	8.9	3.9	1.5	69.5
No. 3:						
Average ---	44	1.39	10.0	4.3	1.8	72.2
Maximum ---		1.66	11.6	4.8	2.2	74.2
Minimum ---		1.22	9.3	3.8	1.5	70.6
No. 4:						
Average ---	42	1.38	10.1	4.4	1.8	72.2
Maximum ---		1.71	11.8	4.7	2.3	74.3
Minimum ---		1.24	8.9	3.8	1.4	70.3
No. 5:						
Average ---	37	1.39	10.1	4.3	1.7	72.1
Maximum ---		1.84	11.3	4.9	2.0	74.9
Minimum ---		1.14	8.9	3.7	1.4	70.4
Sample grade:						
Average ---	42	1.40	10.1	4.2	1.5	72.2
Maximum ---		1.67	11.8	4.8	1.9	74.6
Minimum ---		1.20	8.9	3.4	1.2	70.0
Difference in percentage composition:						
Average between grades--		0.03	0.1	0.2	0.5	0.1
Within grades-----------		.70	2.9	1.4	1.1	4.7

TABLE 7.--Composition of commercial yellow corn, by locations

[Moisture-free basis]

Location	Analyses	Composition of yellow corn				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
	Number	%	%	%	%	%
Peoria--------	68	1.33	9.7	4.4	1.8	72.6
Omaha---------	66	1.44	10.2	4.3	1.9	71.9
Minneapolis---	67	1.37	10.1	4.4	1.8	71.8
Cedar Rapids--	30	1.36	10.0	4.4	1.7	72.5
Toledo--------	22	1.42	10.2	4.3	1.7	72.2

TABLE 8.--Composition of commercial yellow corn, by years

[Moisture-free basis]

Year	Analyses	Composition of yellow corn				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
	Number	%	%	%	%	%
1941----	29	1.36	10.9	4.4	1.6	72.0
1943----	19	1.37	9.8	4.3	1.8	72.8
1944----	28	1.41	9.9	4.4	1.6	72.5
1946----	30	1.37	10.0	4.4	1.6	72.0
1947----	30	1.49	10.4	4.3	1.9	71.6
1948----	18	1.36	9.9	4.6	2.0	72.0
1949----	16	1.35	9.9	4.2	2.0	71.9
1950----	17	1.31	10.0	3.9	1.7	72.4
1951----	18	1.35	9.6	4.0	1.7	73.0
1952----	16	1.36	9.8	4.4	2.1	72.3
1953----	14	1.39	9.9	4.5	1.9	71.2
1954----	18	1.43	9.7	4.6	---	72.4

TABLE 9.--Analysis of variance of compositional data on commercial yellow corn from 5 locations, 1941, 1944, 1946, and 1947

Source of variation	Degrees of freedom	Mean square				
		Ash	Protein	Oil	Sugars	Starch
Location---	4	0.091*	1.895*	0.108	0.055*	4.870*
Years------	3	.102*	6.250**	.107	.736**	4.617*
Location X year-----	12	.023**	.382**	.064**	.017	1.028**
Grades-----	5	.004	.126	.096**	.648**	.050
Grade X location-	20	.003	.095*	.026	.007	.333
Grade X years----	15	.003	.077	.017	.008	.081
Grade X location X years--	[1] 57	.004	.053	.016	.013	.362

[1] Values calculated for samples missing: No. 5, Omaha, 1941; No. 5 and S.G., Toledo, 1944.

* Significant at 5-percent level by F test.

** Significant at 1-percent level by F test.

TABLE 10.--Composition of commercial white corn compared with yellow corn for similar areas, grades, and years

[Moisture-free basis]

Grade	Crop year	Composition of white corn					Composition of yellow corn[1]				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch	Ash	Protein (Nx6.25)	Oil	Sugars	Starch
		%	%	%	%	%	%	%	%	%	%
		St. Louis					Peoria				
1---	1948	1.33	9.1	4.2	2.3	73.5	1.39	9.4	4.8	2.3	71.6
1---	1949	1.38	9.8	4.0	2.0	73.2	1.18	9.3	4.4	2.0	72.1
1---	1951	1.28	8.4	3.8	2.0	75.6	1.33	8.9	4.4	1.9	73.9
1---	1952	1.30	9.8	4.1	2.4	73.4	1.33	9.6	4.6	2.4	72.2
1---	1953	1.39	10.4	4.1	2.2	70.7	1.37	10.1	4.8	2.2	71.3
1---	1954	1.25	10.4	4.1	2.2	73.5	1.40	9.9	4.3	---	72.8
Average---		1.32	9.6	4.0	2.2	73.3	1.33	9.5	4.6	2.2	72.3
2---	1948	1.37	9.2	4.2	2.1	73.4	1.32	9.2	4.6	1.9	72.5
2---	1949	1.27	9.6	4.1	2.1	73.2	1.31	9.3	4.2	2.0	72.5
2---	1950	1.38	8.8	4.1	1.9	74.1	1.24	9.2	4.1	1.8	73.5
2---	1954	1.26	10.2	3.9	2.2	73.7	1.38	10.4	4.7	---	72.2
Average---		1.32	9.4	4.1	2.1	73.6	1.31	9.5	4.4	1.9	72.7
		Omaha					Omaha				
1---	1948	1.42	10.2	4.1	2.1	72.3	1.43	9.8	4.6	2.1	71.7
2---	1948	1.13	10.2	3.8	1.7	74.0	1.41	10.2	4.3	2.0	71.6

[1] Cf. tables 1-5.

TABLE 11.--Composition of commercial oats from 3 locations, 1946-1955

[Moisture-free basis]

Location and grade	Crop year	Composition of oats				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
		%	%	%	%	%
Minneapolis:						
1 Heavy White--------	1946	3.50	14.5	5.3	1.4	38.5
Do-----------	1947	3.71	13.9	5.4	1.7	41.0
Do-----------	1948	3.53	14.4	4.6	1.3	42.4
Do-----------	1950	3.91	14.7	5.1	1.5	40.2
1 Extra Heavy White-	1951	3.79	13.7	5.0	1.6	41.8
1 White--------------	1952	3.67	14.2	5.0	1.6	40.7
Do-----------	1953	3.57	13.6	4.8	1.3	40.9
Do-----------	1954	3.89	13.4	5.1	1.4	40.1
Do-----------	1955	3.73	13.5	4.8	1.5	39.8
Average------------	----	3.70	14.0	5.0	1.5	40.6
Cedar Rapids:						
1 White--------------	1946	3.64	14.2	5.2	1.3	38.7
Do-----------	1947	3.69	14.3	5.0	1.7	40.3
Do-----------	1948	3.67	14.5	4.4	1.4	43.1
Do-----------	1949	3.67	14.1	4.2	1.5	42.1
Do-----------	1950	3.77	13.8	5.1	1.5	41.2
Do-----------	1951	3.64	13.4	4.6	1.4	41.6
Do-----------	1952	3.87	14.2	4.5	1.3	41.7
Do-----------	1953	4.00	13.6	4.6	1.3	42.1
Do-----------	1954	3.81	14.2	4.6	1.4	39.6
Do-----------	1955	3.88	13.3	5.0	1.4	40.1
Average------------	----	3.76	14.0	4.7	1.4	41.0
Fort Worth:						
1 Red----------------	1949	4.03	14.3	6.0	1.2	38.4
Do-----------	1952	4.03	12.2	6.3	1.2	38.9
Do-----------	1953	3.77	14.2	6.4	1.3	37.6
Do-----------	1954	4.06	12.4	6.6	1.3	40.3
Do-----------	1955	3.88	12.1	6.0	1.2	39.0
Average------------	----	3.95	13.0	6.3	1.2	38.8

TABLE 12.--Composition of commercial yellow milo from 2 locations, 1946-1955

[Moisture-free basis]

Location and grade	Crop year	Composition of yellow milo				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
		%	%	%	%	%
Kansas City:						
1------------	1947	1.84	10.1	3.6	1.6	74.7
1------------	1948	1.81	10.4	3.6	1.5	73.2
1------------	1949	1.79	11.3	3.4	1.6	72.2
1------------	1953	2.13	11.4	3.5	1.5	73.6
1------------	1954	1.64	13.9	3.6	1.6	71.6
1------------	1955	1.68	12.6	3.5	1.4	72.8
Average----	----	1.82	11.6	3.5	1.5	73.0
2------------	1947	2.08	11.4	3.6	1.8	72.5
2------------	1948	1.75	11.4	3.5	1.5	73.1
2------------	1949	1.81	11.9	3.2	1.5	71.0
2------------	1953	1.52	12.1	3.2	1.4	72.8
2------------	1954	1.76	13.1	3.7	1.6	71.6
2------------	1955	1.67	12.7	3.5	1.4	72.2
Average----	----	1.76	12.1	3.4	1.5	72.2
3------------	1947	2.05	11.8	3.7	1.8	71.9
3------------	1948	1.75	11.6	3.3	1.5	72.3
3------------	1949	2.30	12.3	3.0	1.7	69.6
3------------	1953	1.54	11.4	3.4	1.4	73.7
3------------	1954	1.70	12.0	3.6	1.3	72.5
3------------	1955	1.59	12.4	3.5	1.3	74.1
Average----	----	1.82	11.9	3.4	1.5	72.4
4------------	1947	1.97	12.6	3.6	2.1	70.6
4------------	1948	1.83	11.2	3.4	1.5	72.1
4------------	1949	2.17	13.1	2.8	2.9	66.4
Average----	----	1.99	12.3	3.3	2.2	69.7
Sample grade-	1947	2.06	9.9	3.4	.9	74.6

TABLE 12.--Continued

Location and grade	Crop year	Composition of yellow milo				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
		%	%	%	%	%
Fort Worth:						
1	1946	1.65	12.2	3.4	1.5	72.6
1	1948	1.62	11.2	3.5	1.5	72.6
1	1950	1.51	12.6	3.3	1.4	71.8
1	1951	1.72	12.6	3.7	1.5	71.2
1	1953	1.61	11.2	3.4	1.5	72.9
1	1954	1.64	11.7	3.5	1.4	74.5
1	1955	1.63	11.2	3.6	1.4	74.9
Average	----	1.63	11.8	3.5	1.5	72.9
2	1946	1.74	13.2	3.5	1.3	71.0
2	1948	1.71	11.1	3.4	1.5	72.7
2	1950	1.53	11.5	3.0	1.3	73.4
2	1951	1.69	11.6	3.5	1.4	72.9
2	1953	1.52	11.3	3.3	1.6	73.5
2	1954	1.70	12.3	3.5	1.4	72.5
2	1955	1.66	11.2	3.4	1.4	73.7
Average	----	1.65	11.7	3.4	1.4	72.8
3	1948	1.57	13.2	3.4	1.4	70.8
Sample grade	1946	1.78	11.8	3.3	0.6	74.0
Sample grade	1948	1.65	13.1	3.4	1.0	71.2

TABLE 13.--Composition of commercial white kafir from 2 locations, 1946-1955

[Moisture-free basis]

Location and grade	Crop year	Composition of white kafir				
		Ash	Protein (Nx6.25)	Oil	Sugars	Starch
		%	%	%	%	%
Kansas City:						
1-------------------	1949	2.16	11.3	4.0	1.6	70.9
1-------------------	1954	1.64	13.2	3.6	1.4	71.7
Average-----------	----	1.90	12.2	3.8	1.5	71.3
2-------------------	1947	2.00	12.6	3.7	1.8	72.4
2-------------------	1949	1.93	12.1	3.9	1.7	69.9
2-------------------	1954	1.82	13.4	3.6	1.3	72.4
2-------------------	1955	1.90	11.6	3.4	1.6	73.1
Average-----------	----	1.91	12.4	3.6	1.6	72.0
Sample grade--------	1949	2.21	12.5	3.7	0.7	68.0
Fort Worth:						
1-------------------	1953	1.56	10.6	3.6	1.3	74.3
1-------------------	1954	1.61	11.6	3.6	1.3	74.4
1-------------------	1955	1.63	10.7	3.4	1.2	75.7
Average-----------	----	1.60	11.0	3.5	1.3	74.8
2-------------------	1946	1.91	10.6	3.1	1.4	73.3